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Medical audit

Pancreatic injury: an audit and a practical approach

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Pancreatic injuries are uncommon, difficult to diagnose and there is no uniform standard for treatment. The purpose of this study was to audit the management of pancreatic injuries in our practice. Equally important is to attempt to find out a simple management plan particularly in the era of increasing conservative treatment of injured patients. There were 22 cases of pancreatic injury. The average Glasgow coma scale of 10.9 and injury severity score of 29.1. When computed tomography is used it has a sensitivity of 33.3% which became 100% if repeated or other injuries were identified. There was one case in grade I which was treated non-operatively. There were 15 patients in grade II and they were treated by drainage. Distal pancreatectomy and splenectomy was the treatment of 3 patients with grade III injury. One patient had pancreatico-jejunostomy for grade IV injury and subsequently developed pancreatic fistula. Pancreaticoduodenectomy was the treatment of choice for two patients with grade V and both subsequently died. The over all mortality of this series was 22.7% and intra-abdominal abscesses noted in 9.1%. This series indicated that there is a need to adopt 'bail out' procedures particularly in grade IV and V pancreatic injury. A simplified management plan is suggested.

Key words: Pancreas – Pancreatic injuries – Pancreatic surgery

Pancreatic injury represents a major challenge to any trauma surgeon. The injury is uncommon, representing about 10% of all abdominal injuries[1] and, as such, experience in treating pancreatic injury is not wide. The anatomical location of the pancreas in the retroperitoneal space and the adjacent major vascular and vital structures makes access and the assessment of the injuries a major operative task. The operative management of the injury depends on the full exposure of the pancreas, understanding the various classifications of pancreatic injury and various operative techniques.

There is no universally accepted grading system to pancreatic injury. This has led to difficulties interpreting published data for comparison. Lucas[2] described a

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grading system of four grades and this system has been used by several authors.[3] However, the Organ Scaling Committee of the American Association for Surgery of Trauma, as described by Moore,[4] is considered comprehensive for the purpose of reporting results and for comparing the various management options.

Pancreatic injury is rarely isolated.[5] Liver, spleen, duodenal and major vascular injury occur with pancreatic injury and make an operative decision rather complex. It is perhaps important to distinguish between blunt and penetrating pancreatic injury. These injuries are not only different in the injury mechanism but also in the disease process. Penetrating injury is usually localised to the abdomen and, most likely, will be explored prior to any utilisation of diagnostic tools. Blunt trauma usually involves several systems, particularly head and chest injuries, which require further diagnostic evaluation and the outcome is not only related to the abdominal injury but also to the severity of injury in other organ system.

Traditionally, several operative manoeuvres have been described to deal with complex pancreatic injury. These procedures include distal pancreatictomy, Whipple's procedure, duodenal diverticulisation, duodenal exclusion, pancreatico-jejunostomy and pancreatico-gastrostomy. These are a few of the operative procedures that every trauma surgeon should be aware of and he/she has to select one of these procedures to meet the operative findings. This adds to the difficulty, which faces any trauma surgeon.

Recent advances in trauma surgery, based on the detailed understanding of pathophysiological changes after injury, have led to new concepts in the management of traumatised patients. The trend toward conservative approach, the understanding of the concept of secondary injury and the evolution of the concept of 'damage control' necessitate the subject of pancreatic injury to be revisited.

The purpose of this paper is to audit our practice of management of pancreatic injury. Equally important is to try to find a simple and effective management plan, in the light of recent knowledge, to help us in the future management of pancreatic injury.

Patients and Methods

This is a retrospective review of all patients with pancreatic injury admitted to the King Fahad National Guard Hospital, Riyadh, Saudi Arabia. This review covered a period from 1983 to 1997. All patients, paediatric and adult were included in this review. Special attention was given to the mechanism of injury, diagnostic tool, associated injuries, management of the pancreatic injury, complications and mortality. The pancreatic injuries were classified according to the American Association for the Surgery of Trauma (AAST) Organ Injury Scaling Committee (Table 1).[4] In every patient, the injury severity score (ISS),[6] as well as the Glasgow coma score,[7] were measured.

Table 1 Pancreatic injury scale

Grades	Injury
I	Minor contusion or laceration without ductal injury
II	Major contusion or laceration without a ductal injury
III	Distal transection or parenchymal injury with ductal injury
IV	Proximal transection or injury involving duct or ampulla
V	Massive disruption of the pancreatic head

According to the Organ Injury Scaling Committee of the American Association for the Surgery of Trauma.

Results

A total of 22 patients were found to have pancreatic injury. There were 21 male and only one female. The average age was 15.5 years (range 2–65 years). Only 3 patients (13.6%) were in the paediatric age group. The mechanism of injury was mainly blunt trauma (19, 86.4%) due to adult unrestrained drivers or a pedestrian in the paediatric age group. Low velocity gunshot injury of the pancreas was noted in 2 patients (9.1%) and a stab injury in one (4.5%). Because of the high incidence of blunt injuries, the Glasgow coma score was checked and the average was 10.9 (range 4–15). The initial diagnosis of possible pancreatic injury was made by clinical findings in 9 patients (40.9%) (3 had a penetrating injury requiring laparotomy and 6 had evidence of acute abdomen). Diagnostic peritoneal lavage (DPL) made the diagnosis in 4 cases (18.2%) by finding haemoperitoneum necessitating exploratory laparotomy. Computed tomography (CT) was done in 9 (40.9%) patients; however, pancreatic injury was identified in only 3 (sensitivity 33.3%) and 6 patients had signs of other intra-abdominal injuries (haemoperitoneum, free gas and non-perfusion of the right kidney) requiring laparotomy where pancreatic injury was identified. The initial CT was diagnostic in only 2 patients, but was negative in one when a repeated CT scan 48 h later diagnosed the isolated transection of the pancreas. Serum amylase was checked in only 6 patients and was found high in 4 (sensitivity 66.7%).

Table 2 Distribution and management of patients with pancreatic injury

Grade	*n*	Management
I	1	Non-operative
II	15	Drainage; one patient had pyloric exclusion added
III	3	Distal pancreatectomy and splenectomy
IV	1	Pancreatico-jejunostomy Roux-en-Y
V	2	Whipple's procedure

n = Number of patients

As patients with blunt trauma had other associated injuries, we calculated the ISS and the average of this group was 29.1 (range 16–50). The most common associated intra-abdominal organ injury was the duodenum 5 (22.7%), right kidney 3 (13.6%), liver 3 (13.6) and spleen 2 (9.1%). Involvement of the inferior vena cava (IVC), common bile duct (CBD) and portal vein was documented in 2 (9.1%) patients.

If we consider the pancreatic injury according to the AAST scale, Table 2 shows the distribution of our patients in relation to this scale. The management of each grade is outlined in Table 2. From this table, the grade I patient was managed successfully by conservative treatment. Grade II patients were managed by drainage, except one case where pyloric exclusion was added. The grade III patient was managed with distal pancreatictomy with splenectomy. The grade IV patient was managed by pancreatico-jejunostomy Roux-en-Y, but this patient developed a pancreatic fistula. Grade V patients were managed by Whipple's procedure.

The mortality rate was 22.7% (5 patients). Two patients (9.1%) had head injury; both patients had GCS of 4 and ISS of 50. Coagulopathy was the contributing factor for death in a further 2 patients (9.1%); one patient had a GCS of 4 and ISS of 50 and head injury may have contributed to his death. An iatrogenic cause of death was noted in a patient post Whipple's procedure. This patient had inappropriate treatment of his hypokalaemia. Table 3 summarises the causes of death. Fistula formation was observed in 1 patient (4.5%) which was treated conservatively and healed after 4 weeks. Abscess formation was noted in 2 patients (9.1%) and both required surgical drainage. Other specific complications included coagulopathy in 2 (9.1%) patients, one (4.5%) duodenal stenosis and one patient with fluid collection treated by percutaneous drainage.

Discussion

The diagnosis of pancreatic injury will depend on the recognition of such injury, determination of the integrity of the main pancreatic duct and grading of the severity of the injury. Distinction between penetrating versus blunt trauma of the pancreas is essential. In penetrating trauma, the diagnosis is almost always made at the time of laparotomy. In blunt trauma there is usually time to determine the diagnosis by diagnostic aids. Interpretation of the diagnostic tools, however, should be examined carefully. In our series, we found serum amylase is positive in 66.6% which is in keeping with the previously published data that serum amylase may show false negative results in approximately one-third of patients.[8] A CT scan of the abdomen, with contrast, may be the modality of choice for determining pancreatic injury or, better still, the need for laparotomy. In our group, the sensitivity of CT scan for pancreatic injury was low (33.3%) but other CT findings, like free gas or blood in the peritoneal cavity, increases the sensitivity for the need for exploratory laparotomy to 100% where pancreatic injury could be identified. The sensitivity of the CT scan is also increased by serial examination after 48 h when the manifestation of pancreatic injury becomes apparent.[9] The yield of CT scan would improve if we consider fluid in the lesser sac, extraperitoneal fluid, thickening of the anterior renal fascia and fluid between the splenic vein and the pancreas as indirect signs of pancreatic injury as reported by Lane.[10] We still consider CT is the diagnostic tool of choice for blunt pancreatic injury.

The intra-operative technique of exploration of the pancreas at the time of laparotomy is standardised[1] to

Table 3 Mortality after pancreatic injury

Case	Injury scale	ISS	GCS	Other injuries	Procedure death	Cause of
1	II	50	4	Duodenal laceration	Drainage repair of duodenum	Head injury
2	II	50	4	Duodenal laceration	Drainage repair of duodenum	Head injury
3	III	50	4	Liver + spleen	Distal pancreatectomy + splenectomy + packing liver	Coagulopathy ARDS
4	V	25	15	IVC + duodenum	Whipple	Coagulopathy + ARDS
5	V	50	8	Portal vein + avulsion right kidney	Whipple	Hypokalaemia

Table 4 Proposed management plan for pancreatic injury. Feeding jejunostomy should be added

Grade	Proposed management
I	• Non-operative if diagnosed by CT, consider early ERP • Drainage
II	Drainage
III	Distal pancreatectomy + splenectomy
IV	External drainage + pyloric exclusion
V	• Stable patients → Whipple • Unstable patients → External drainage + pyloric exclusion + packing (as needed)

include examination of the lesser sac, mobilisation of the duodenum by the Kocker manoeuvre and mobilisation of the tail of the pancreas. We consider mobilisation of the right colon and hepatic flexure as an essential step for pancreatic exploration. During Kockerisation of the duodenum, the mobilisation should be taken as medial at the level of the aorta for proper examination of the uncinate process as well as identification of any vascular injuries to the surrounding major vessels. Certain operative findings may indicate the presence of pancreatic injury. These include the presence of central retroperitoneal haematoma, free bile in the peritoneal cavity, oedema of the pancreas and the presence of saponification of the retroperitoneal fat.[11] The key issue in the management of pancreatic trauma is to identify the major pancreatic duct injury. Proper inspection will, usually, be sufficient to determine the injury of the pancreatic duct.[12] Determination of ductal injury by intra-operative ERP (endoscopic retrograde pancreatography)[13] or direct pancreatography through the ampulla of Vater[14] has been advocated. We have had no experience of these two techniques and feel they are not practical in critically injured patients. However, in stable patients where conservative treatment is advocated, early ERP may be indicated if there is suspicion of pancreatic ductal disruption. The literature is scanty about early ERP in pancreatic trauma, but the work of Rescorla[15] in paediatric patients is noteworthy.

'The pendulum swings', as described by Mattox,[16] indicates the recent changes in the concept of management of complex trauma. Aggressive surgical approaches and extensive reconstruction procedures in severely injured patients had led to early mortality secondary to hypothermia, coagulopathy and acidosis. The better understanding of these conditions has led to an increasingly conservative approach and subsequent introduction of the 'damage control' concepts in the management of complex injuries.[17] These principles and concepts have a major impact in the recent management of pancreatic injuries. We critically reviewed our cases in the light of these recent concepts. The conservative approach in treating grade I injuries and the simple drainage in grade II injuries are in keeping with the conservative principles. Grade III injury was treated by distal pancreatectomy and splenectomy, as this is a quick procedure. We do not think that, in adults, there is room to preserve the spleen as this unjustifiably increases the operative time. One may argue that in an unstable patient with a grade III pancreatic injury may be drained externally as a 'bail out procedure'. Our approach in grade IV injury needed a change. Pancreatico-jejunosomy Roux-en-Y is a complex procedure in the face of this major injury. Perhaps external drainage with pyloric exclusion should be the optimum management, particularly in the case of haemodynamically unstable patients. Two of our patients with grade V injury had the Whipple procedure and subsequently died. Experience in this category of injury is scarce and, as such, any recommendation should be validated before it becomes an approved practice. Damage control procedure in unstable patients in the form of externally draining the pancreas, billiary tree and duodenum, packing together with pyloric exclusion could be the only life-saving approach. However, in a stable patient, pancreaticoduodenectomy with or without reconstruction[18] may be a valid option. Table 4 summarises our management preference in the five grades of pancreatic injury.

Feeding jejunostomy is considered an important element in the surgical management of pancreatic injury. It does not only facilitate the nutritional support for the patients but also help to prevent septic complications.[19] Jejunal feeding will be of great importance should a pancreatic fistula occur. Other therapeutic modalities have been investigated in order to speed up the healing process of pancreatic fistula. Of great interest, and with conflicting benefit, is the use of octreotide, which was reported to reduce the pancreatic fistula output and facilitate the rate of closure of the fistula.[20] We used octreotide in only one of our patients and it helped reduction of the fistula output. Nawriaku,[21] however, has shown in a non-randomised trial that there is no beneficial effect from the use of octreotide in pancreatic fistula. Use of octreotide needs further evaluation in a controlled setting to clarify its role, if any, in the management of pancreatic fistula.

Conclusions

This audit has demonstrated the important role of abdominal CT in the diagnosis of pancreatic injury. The operative management of our cases has to change to

meet the recommendation stated in Table 4. The routine use of feeding jejunostomy is strongly recommended. Our mortality of 22.7% is within the published range of 12–30%,[21] taking into account that our patients predominantly sustained blunt trauma. Intra-abdominal abscesses were reported to be between 8–34%[22] and were observed to be 9.1% in our series.

With the new changes in the concepts of trauma care, mainly damage control, no one can claim to have a wide enough experience to indicate appropriate management options. The options in Table 4 need to be tested further. Trauma surgeons should be encouraged to report their recent experience in the management of both blunt and penetrating pancreatic injuries.

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